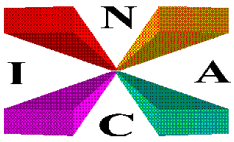
NAS Information Architecture Committee



CONFERENCE PROCEEDINGS
of the
NIAC DATA ARCHITECTURE CONFERENCE
April 21-22, 1998

EXECUTIVE REPORT

Prepared by:

Dimensions International, Inc.
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Executive Report

NIAC Data Architecture Conference Proceedings Report

TABLE OF CONTENTS

Executive Summary

The National Airspace System (NAS) Architecture was developed to provide a high level overview of the behavioral characteristics that will be intrinsic to the NAS in 2005. It describes significant changes that must be made in and outside the FAA to meet the needs of airspace users, and to increase efficiency and effectiveness, while accommodating global growth of airspace. A critical characteristic of the NAS is interoperability -- the capability to exchange data and information between and among applications and platforms.

In January 1997 representatives of several FAA organizations which share understanding of the objectives described in the Architecture joined to form the NAS Information Architecture Committee (NIAC). The NIAC's purpose is to guide, direct and coordinate the establishment and future management of information-based processes and procedures that will accomplish interoperability of systems across the NAS via data standardization and data exchange. NIAC co-chairs assembled a steering committee and obtained funding from other FAA organizations to design and conduct a conference to increase understanding of the implications of sharing NAS information. The steering committee met weekly from December 1997 to April 1998 to plan a 2-day conference for the FAA, selected government agencies, and contractors who are supporting NAS operational systems. The committee identified six important issues surrounding interoperability and prepared a list of NAS "stakeholders" who should be invited to participate in discussion of those issues.

The conference, "Achieving Interoperability with a NAS Common Data Architecture", held April 21 and 22, 1998 is the first of several participatory symposia on issues of interoperability. Support for the conference theme was presented in letters from the FAA Administrator, Ms. Jane Garvey and the Acting Associate Administrator for Air Traffic Services, Mr. Ron Morgan. The conference theme was also underscored in the conference keynote address given by Dr. Anne Harlan, the Director of the W.J. Hughes Technical Center, as well as the other presentations made by key FAA staff, ATM experts from EuroControl, and the renowned Systems Architect, Dr. Eberhardt Rechtin. Almost 200 FAA managers, systems engineers, analysts and contractor staff then participated in six parallel "Work Sessions" on the key issues, and presented recommended approaches to the full session at the end of the conference.

The primary goals of the two-day conference were not only met, but several were exceeded. These goals include: promoting awareness of the process for defining a data architecture, determining how the pieces of an integrated environment fit together, starting to develop a transition strategy, identifying areas needing further technical development, and beginning a collaborative process to change the culture. The conference produced a series of individual Work Group Action Plans or "next steps" towards achieving interoperablity with a NAS Common Data Architecture. The conference also produced a great number of participants who enthusiastically volunteered to participate in follow-activities with their respective conference work groups. Other significant conference outcomes were the development of a draft FAA Policy on a Global Aviation Information Management System and tasking to identify interoperability opportunities within Free Flight Phase 1 (FFPI) and follow-on phases. These activities will be further expanded at the next NIAC sponsored conference that will grow to include other NAS system users and providers from the Aviation Community.

In general, the plans of action include action items that are definitive, concrete, and measurable. Some of the action items overlap among the work groups and some may overlap with existing or planned NAS initiatives. Some plans identify specific individuals or groups to take action by a specified date, but most assume that the NIAC will take the lead and accomplish the action items within a reasonable time frame.

The first tier action items from each of the six work groups' plans of action are as follows:

GROUP 1: MANAGEMENT ACTION PLAN

1. Draft FAA policy on Global Aviation Information Management System (GAIMS).
2. Initiate Free Flight Phase I (FFPI) under the "interoperability" concept:
   - 2.1 Baseline FFP1: Data Model
   - 2.2 Identify Data and Develop Tools to Support Metrics
   - 2.3 Correct Site Adaptation Problems
   - 2.4 Identify Interoperability Opportunities for Follow-On FF Phases and NAS-Wide System Development Activities

GROUP 2. NAS DATA QUALITY ACTION PLAN

1. Develop a Matrix of National, Local, & System versus Policies, Standards, & Data Structures.
2. Create an Expanded Data Dictionary.
3. List goals for data quality.
4. Describe why requirements for DQ are necessary.
5. Describe why data should be accessible to needed party.

GROUP 3. NAS BUSINESS OBJECTS ACTION PLAN

1. Establish a work group to determine the Scope, Outcome, and Metrics, Process(es).
2. Identify, address group learning needs.
3. Identify, gather what's been done so far.
4. Determine what needs to be done, including coordination, integration, etc. Look at sharing of data—ownership and management and make recommendations for NAS-wide implementation.

GROUP 4. NAS FLIGHT INFORMATION OBJECT (FIO) ACTION PLAN

1. Establish Dialog with Service Providers, Users and producers of major ATC DSS tools, e.g., CDM, CTAS, URET, and SMA.
2. Define and Produce Standards for the FIO.
3. Produce Operational Requirements for the FIO.
4. Define Memoranda of Agreement (MOA) with Air Traffic Service Providers and Users to define Operational Requirements.

GROUP 5. TRANSITION TO INTEROPERABILITY ACTION PLAN

1. Establish coordinated Metadata Repository under CM.
2. Develop process for prioritizing/categorizing data to be shared.
3. Develop process for defining interface/integration standards for interoperability across stovepipes.
4. Get NIAC Charter signed at the Associate level.
5. Incorporate process & organization to proceed with development of the Data Architecture in sync with the next version of the NAS Architecture.

GROUP 6. NAS-wide INFORMATION SYSTEM (NIS) PERFORMANCE

1. Identify who the Users are.
2. Identify how many users have to be serviced.
3. Identify how to define metrics of each performance requirement; Identify design review and set intervals between acceptance testing; and Identify all approaches.
4. Identify how to prioritize when multiple users wish concurrent access.
5. Identify how to translate operational requirements into specific information architectural performance requirements.

Based on a review of the work group plans of action, the major post-conference responsibility of the NIAC is to develop an overall action plan to achieve these conference outcomes through a well-planned, realistic and coordinated effort. To this end, the NIAC will set up a core group made up of members of the Conference Planning Committee to oversee and follow through on the achievement of conference outcomes. The NIAC will first identify common and unique action items among the six work groups' plans of action. The NIAC will also develop a listing of ongoing NAS initiatives in order to identify those action items that are already under way or in the planning stages. Based on the results of these two parallel efforts, the NIAC will finalize an action plan that sets up subcommittees/work groups to carry out the above-cited plans of action. These subcommittees/work groups will scope out the action items, specify specific individuals/groups to carryout those action items, and specify realistic timeframes. In some cases, the subcommittees/work groups may reflect one or more of the conference work groups. However, the NIAC will set up subcommittees/work groups that will incorporate the common action items among the six work groups as well as common action items with ongoing or planned NAS initiatives.

The full texts of all speeches, letters, presentations, and work group plans of actions are provided on the NIAC web page **(http://www.faa.gov/niac)**. Additionally, the NIAC will continue to track progress on the work groups' plans of action. Results and updates will be presented at the monthly NIAC meetings and posted periodically on the web page. NIAC meetings are held on the last Thursday of each month; see the web page for time and place.

1.0 PURPOSE OF THE EXECUTIVE REPORT

The NAIC Data Architecture Conference Proceedings Executive Report presents a comprehensive overview of major speeches, presentations, and work group action plans from the NIAC Data Architecture Conference held on April 21-22, 1998 at the Mitretek conference facility. The report is made up of three major sections. Section 1 presents the background and purpose of the conference, the conference goals and objectives and the Conference Agenda. Section 2 contains highlights of the speeches/letters from the General Session and an overview of the purpose and scope of the work groups. Section 3 presents a summary of conference outcomes and recommendations. The full texts of all speeches, letters, presentations, and work group plans of actions are provided on the NIAC web page (**http://www.faa.gov/niac**).

1.1 Background and Purpose of the Conference

The NAS may be viewed as an information system of systems that collectively support all air operations in the US and certain oceanic areas. Viewed in this light, the NAS can be divided conceptually into three parts:

1. Sources of information necessary to perform air operations.
2. Users, who use the information to perform air operations and who, in the course of performing them, produce additional information.
3. Access and management of the information between sources and users.

The NAS Architecture is developed to provide a high level overview of the behavioral characteristics that will be intrinsic to the NAS in 2005. It describes significant changes that are needed to meet the needs of users, and to increase efficiency and effectiveness, while accommodating global growth of airspace. A critical characteristic is **interoperability -- the capability to exchange data and information between and among applications and platforms.**

The NAS Architecture clearly recognizes that the exchange of NAS data and information cannot occur without standards-compliant data and information. To achieve interoperability the NAS Architecture will rely on multiple standards, including networking, data modeling, data administration, data security, Data Base Management System (DBMS), and open systems environments.

The NAS Information Architecture Committee (NIAC) was formed in January 1997 to guide, direct and coordinate the establishment and future maintenance of information-based processes and procedures that will enable interoperability of systems across the NAS via data standardization and data exchange at the minimum cost consistent with high quality. The Committee operates under the auspices of the Associate Administrator for Research and Acquisitions (ARA) and designates various Working Groups to provide advice, recommendations, research and studies.

In 1997, the NIAC authorized the Data Architecture Conference Planning Committee to begin planning for a Data Architecture Conference to be held in the third fiscal quarter of FY 1998. The Data Architecture Conference Planning Committee met on weekly basis from December 1997 through April 1998 to design, develop, and conduct the proposed conference. A list of the conference planning committee is provided on the NIAC web page (**http://www.faa.gov/niac**) and can be downloaded.

This conference, entitled
a Series of Participatory Symposia and Colloquia on Understanding the Implications of Sharing NAS

Information," is intended for the FAA to lay the groundwork for continued planning to address the vital issues surrounding interoperability. The conference is jointly sponsored by the:

- Office of Air Traffic Systems Development (ARA/AUA)
- Office of System Architecture and Investment Analysis (ARA/ASD)
- Office of Information Technology/Chief Scientist for Software Engineering (ARA/AIT)
- Office of Telecommunication Support and International Communications (ATS/AOP)

The conference is the first of several forums to address other NAS Data Architecture issues as well as expand the participation throughout the aviation community.

1.2 Conference Goals and Objectives

The purpose of the conference is to pave the way for achieving a NAS common data architecture to accomplish interoperability as required by A Concept of Operations for the National Airspace System in 2005[1] and the NAS Architecture.

The conference is designed for NAS stakeholders to confer on the critical issues surrounding an integrated information architecture in order to achieve an infrastructure that will be created incrementally. The underlying goals of the two-day conference are to:

1. Promote awareness and understanding of the process, structure, standards and requirements for defining a data architecture for an effective and affordable NAS information system infrastructure;
2. Begin to answer how all the pieces fit together in an integrated environment, concentrating on reducing the interfaces among systems;
3. Develop the process for accomplishing a NAS common data architecture and transition strategy;
4. Identify the areas that require technical development;
5. Develop a collaborative process to change the culture.

The conference is designed to meet the following specific objectives:

1. Strengthen ***consensus*** of the need to migrate toward a more modern system with one NAS Data Architecture;
2. Identify and cultivate NAS stakeholder ***relationships***;
3. Identify ***program requirements*** and ***issues*** for an integrated NAS Data Architecture;
4. Build ***alliances*** among participating organizations;
5. ***Leverage*** system developers' know-how assets into more airspace and system efficiency;
6. ***Outline*** the requirements for a NAS Data Architecture Steering Committee;
7. ***Show leadership*** in the aviation community by ***identifying*** steps to interoperability via one data architecture.

1.3 Conference Design and Agenda

The scope of the two-day conference is specifically designed for the FAA, government agencies and contractors who are supporting NAS operational systems, both existing and under development. The conference is ***not*** designed to address information security, logistics, maintenance, and administrative

[1] *A Concept of Operations for the National Airspace System in 2005*, Air Traffic Services, September 1997; and *Government/Industry Operational Concept for Free Flight*, August 1997. Together these documents form the basis of the NAS Architecture.

issues. The conference was conducted over a two-day period with up to 200 invited participants made up of FAA and other Federal Agency managers, systems engineers, and their support contractors. A complete listing of all registered participants is provided on the NIAC web page (**http://www.faa.gov/niac**).

The conference provides an interactive, structured setting in which participants have the opportunity to identify key issues surrounding interoperability among the various NAS systems and developing group plans of action to begin resolving these issues. In order for all participants to be able to communicate their specific and general systems' concerns, conference participants were provided a set of basic pre-conference reading materials a month before the conference. The materials included:

- Conference Registration Confirmation Letter
- Draft NAS Architecture 3.0, dated December, 1997
- Draft Federal Information Architecture Initiatives, February, 1998
- Draft NAS Information Architecture Evolution, January, 1998
- Draft Preliminary TFM Information Architecture Steps, January, 1998

Only hard copy of the Draft NAS Architecture 3.0, dated December 1997, are available from the FAA's Office of Systems Development (ASD-110). The other three Draft documents are on the NIAC web page (**http://www.faa.gov/niac**) and can be downloaded.

2.0 CONFERENCE OVERVIEW

Section 2 provides an overview of the major events, speeches, and presentations from the 2-day conference. Subsection 2.1 presents the major events and speeches from the general session. Subsection 2.2 presents an overview of the key interoperability questions addressed in the six parallel work group sessions, the methodology used in the work groups, and an overview of the major outcomes of each of the six work groups.

2.1 General Session

Andy J. Taylor, AUA-500 and member of the NIAC and its Conference Planning Committee emceed the overall conference. During the general session, a series of speakers/support letters provided the conference attendees with background information on the conference theme of "Achieving Interoperability with a NAS Common Data Architecture." The selected speakers who could not attend, due to other pressing commitments, sent letters of support which were included in the participant's conference folders, and excerpts of the letters were read at the general session.

The series and sequence of speakers/support letters were as follows:

- Felix Rausch, NIAC Co-Chair and NAS Information Architecture "Product Lead"
- Letter from Jane Garvey, FAA Administrator
- Letter from Ron Morgan, ATS-1, Acting Associate Administrator for Air Traffic Services
- Keynote address by Dr. Anne Harlan, ACT-1, Director, William J. Hughes Technical Center
- Dr. John Scardina, ASD-2
- Speech by Stan Rivers, AAF-1 given by Thomas Gassert, AOP-1
- Hartmut Koelman, EuroControl, Air Traffic Management (ATM) Expert
- Marc Bourgois, EuroControl, Architecture Expert
- Dr. Eberhardt Rechtin, Internationally Renowned Systems Architect

These general session speakers/support letters provided participants with common, basic information on the task of achieving a common data architecture. Highlights of the themes stressed in each speech/support letter are presented on the following pages. The full texts of the presentations/speeches/support letters are on the NIAC web page (**http://www.faa.gov/niac**) and can be downloaded.

Introduction Themes:

Felix Rausch, NIAC Co-Chair and NAS Information Architecture "Product Lead"

- We are all in this together and must synergize energies.
- Every manager briefed agreed that this is a good idea.
- We live in the age of information, hardware became a commodity and there are new rules of operating in a knowledge society.
- No one can do an excellent, cost-effective job by themselves, dependency is universal.
- Optimizing each system sub-optimizes the whole NAS.
- Sharing information globally will be the basis for Free Flight.
- Sharing information presupposes common interpretation of information otherwise too much is lost in translation ($, meaning, time, and safety).
- We don't have $ and time to waste on duplications to ensure safety.
- The ***NAS Information Architecture*** is...
  - The integration factor within the overall NAS Architecture **FOR ITS INTERFACES.**
  - The way to address and solve the basic NAS information exchange problem.
  - The common denominator that can fundamentally integrate the flow of information across NAS interfaces.
  - The vehicle that allows us to stop mortgaging our future as we change the NAS into an Information System.
- Participants at this conference can contribute by actively engaging in the sessions with your knowledge and ideas and asking questions such as:
  - How do we break the cycle of creating new data, database, translator and LAN fiefdoms?
  - How do we assure better sharing of data within the FAA and with our NAS users?
  - Can we change the way we do business by defining the problem better up front?
  - How can we reduce information management costs in the future so we can reapply the savings to keeping the NAS state-of-the-art.

FAA Letter 1 Themes:

Jane Garvey, FAA Administrator

- The air traffic control system is a massive communications and information system designed to help pilots fly safely and efficiently in the NAS.
- This communications network is made up of a myriad of systems and equipment, many of which "speak" different languages.
- We need to mange the data and information in such a way that all of them can communicate with one another.

FAA Letter 2 Themes:

Ron Morgan, ATS-1, Acting Associate Administrator for Air Traffic Services

- User needs will increasingly cut across many components of the NAS requiring seamless data exchange.
- The NAS will also grow in complexity as new technology advances are incorporated.
- We in the Air Traffic community will depend on timely and consistent sharing of data to assist the decision makers, service providers, and aviation system users.
- There must be a seamless flow of information among facilities and aircraft to allow necessary information management advances to assist in collaborative decision making for future Free Flight.

Keynote Address: Themes:

Dr. Anne Harlan, ACT-1, Director, William J. Hughes Technical Center

- Creating...interoperability is a real challenge to all of us. It is infinitely important to the future of the National Airspace System, and all of air travel.
- The different systems that comprise the NAS have been developed and enhanced over many years. There is no question that these systems are safe and they work well.
- All too often, they acquire their data independently of each other, resulting in a "stovepiping" approach...(that) do not exchange this information as efficiently as they could, and in turn don't serve their maximum potential.
- As more and more systems become automated, it becomes even more important that they share information with each other.
- It is the goal of the FAA to evolve the NAS into a more integrated set of systems with enhanced information standardization and functionality.
- A key step toward this end is commonality among the NAS Architecture components. NAS Architecture must assure that this commonality is achieved.
- At the William J. Hughes Technical Center, we are actively participating in these efforts toward a more collaborative NAS environment. Our NAS System Engineering Branch is now at work developing the Collaborative Data Integration Management System -- the CDIMS.

FAA Presentation 1 Theme: **Dr. John Scardina, ASD-2**

- The NAS Architecture is one of three essential elements of the overall NAS Modernization Plan. The other two are:
  - Detailed Concept of Operation
  - Certification Plan
- Free Flight Phase 1 (FFP1) initially a Core Capability Limited Deployment at selected facilities for early user benefits
  - Controller Pilot Data Link Communications (CPDLC) - Build 1
  - Initial Conflict Probe (ICP)
  - Traffic Management Advisor Single Center
  - Passive Final Approach Spacing Tool (pFAST)
  - Collaborative Decision Making (CDM)
  - CDM at Airports (Limited SMA)
- Goals:
  - Operationally evaluate FFP1 Capabilities by 12/2002
  - Begin national implementation approximately 2004

FAA Presentation 2 Theme: **Stan Rivers, AAF-1**

- The success of AF's development and implementation of its NAS Operations Concept hinges on the ability of its information systems to communicate (exchange information and interoperate).
- The necessity to address information exchange and interoperability is now crossing the boundaries of more than one single organization and more than one line of business.
- This concept and the compelling need of information exchange will encompass the entire FAA as well as our external customers.
- We need to build a collaborative process that emphasizes teamwork - the solution and success are not so much dependent on technology, but in collaboration.
- We want to draw requirements from our stakeholders and involve them in every step of the process.
- AF is already addressing their needs through several current initiatives:
  - The NAS Infrastructure Management System (NIMS);
  - The ATS Corporate Information Management System (CIMS);
  - The NAS Interoperability and Information Standards (NIIS); and
  - The Telecommunications Information Management System (TIMS).

EuroControl

Hartmut Koelman, EuroControl, Air Traffic Management (ATM) Expert
Marc Bourgois, EuroControl, Architecture Expert

Themes:

- We know that vast amounts of information will be circulating in the future ATM system
- The realization of Europe's future ATM concept is dependent on improved information sharing:
  Access to information where & when you need it will be vital.
- The high level principles of SystemWide Information Management (SWIM) will be addressed in upcoming editions of the ATM 2000+ Strategy and the EATMS Operational Concept Document
- Detailed SWIM concepts & strategy will need to be worked out in the near future
- Meanwhile, a number of common development & implementation projects are starting to streamline the European information architecture
- The EUROCONTROL Agency is undertaking Information Architecture studies

Information Architect

Dr. Eberhardt Rechtin, Internationally Renowned Systems Architect

Themes:

<u>Introduction</u>

- The National Airspace (NAS) System is one of the most difficult architectural tasks ever attempted by the United States Government for several reasons:
  - Its agency, the FAA, has very little control over its suppliers, its users, other government agency and, most serious of all, of the airplanes it serves and the equipments they carry.
  - The system is, in reality, a "system of systems" by which is meant a group of semi-autonomous, self-standing, self-managing systems which collectively are supposed to produce results which exceed the sum of their individual results.
  - They are coupled not only together but with international organizations and all three branches of the Federal Government; especially, the Department of Defense, NASA, NOAA, the Department of State, the Treasury, a variety of State and local agencies, the public, the media…and I've probably left some comparably important ones.
- This NAS…is mandated to produce safe, efficient, cost-effective air travel in the interests of all the stakeholders. Note that <u>none</u> of the individual systems individually can do so.
  - They must work together, in close to real time, to do so.
  - The mechanism they use is information.
  - The <u>structure</u> of information generation, processing, transfer, storage, display, understanding, use and response is called an information architecture.
  - Its technologies are communications, computers, displays, satellites and software.
  - Some of us understand this architecture by the term Command, Control, Communications, and Intelligence (C^3I).

Information Architect Themes:

Dr. Eberhardt Rechtin, Internationally Renowned Systems Architect

- By whatever the name, it is the key to the behavior of any system of systems. It is the centerpiece of any and all smart systems of which the NAS is certainly one.

- C3I is now the top priority of the DoD
  - It is the crucial combatant in the Information War.
  - …it won its part of the Gulf War overwhelmingly, greatly reducing the cost and casualties in the other systems.
- But…information systems became joint operators and combatants…
  - They became life-threatening, vulnerable, destructive and error-prone.
  - In procurement, particularly of software, they have blown costs and schedules.
  - In behavior, they have created mathematical chaos.
  - In smart systems, they have become too smart for their own good.
  - These systems have all too often provided examples of the Law of Unintended Consequences. After all, they are designed and operated by 1 % error-rate human beings.
- The technical reason that information systems create such difficulties is because the individual elements must communicate with each other about very important, often urgent operational matters.
  - …and this communication must be accomplished *easily, securely, accurately, and certifiably, all on demand.*
  - If the information systems interfere with the essential tasks of the elements, they will be resisted, to the damage of all parties.

I. The difficulties with everything everywhere, all-the-time, for everybody

- The first thought in resolving such problems is to have all the systems open to each other through the use of common equipment and procedures.
  - It isn't practical for near-autonomous, separately owned, systems doing essential functions for others at their own time and pace;
  - In effect, there is no single date at which all "old" systems can be taken out and "new ones" installed without very high cost and considerable disruption.
  - Worse yet, it is rare that any one system can be completely changed without affecting the systems to which it is connected.
  - I know, we tried it for military satellite systems. We tried it with the NATO nations.
- More important, commonality runs into security, proprietary, and specialization obstacles.
  - In security-sensitive situations, too many people have access to too much information.
  - In proprietary ones, too many competitors will use the system for what is euphemistically called "business intelligence."
  - In areas of specialization, the education necessary to use much of the information in each technically different system is so extensive that few others can begin to understand it.
- But the most important obstacle of all…is that of privacy.

Information Architect Themes: **Dr. Eberhardt Rechtin, Internationally Renowned Systems Architect**

- In a completely open environment, everyone can know anything desired without the knowledge or control of the "owner."
- That is, "Everything you know, I can know. All the information you

- In a system in which the Congress, the media, other agencies, and your enemies have full access…even if you have the time, resources and the patience to answer every damn fool inquiry. NO!

- Each system, in self defense, procures equipments that can't talk to others, like Army, Navy, and Air Force avionics.

II. <u>The real needs when one gets down to it.</u>

- …in the end, unless these "systems within a system" work together, all will fail together. They must communicate. BUT, …"easily, securely, accurately,

  - There is an enormous difference between … "all the time" and "on

  - "Full interoperability" demands are not only unnecessary, they are undesireable and destructive technically and psychologically.

III. <u>Scope. Scope. Scope and other related heuristics.</u>

- These real needs can be satisfied not by "commonality" or "interoperability" but by what might be called "selective interoperbility." To the systems architect, this suggests: ***Scope! Scope! Scope***!
- In other words, first try to reduce the size of the problem by deciding, with the other stakeholders, just which, and to what degree, needs can be met in a practical manner, ***<u>and which can not</u>***.
  - Do all parties understand and agree with the essential needs of the other stakeholders and why?
  - Are all agreed on who will be responsible for maintaining which data base, replying to queries to it, and how that reply will be presented to each inquirer?
  - It is astonishing how much these agreements can reduce the "requirements" list.
- Then, the next step: Simplify. Simplify. Simplify.
  - Is the information in its simplest, most direct, most easily understood form?
  - Is there a simple way of inquiring further in case more is desired?
  - Are meanings of words standardized and is there a glossary that states those meanings?
  - Are there simple rules about message lengths to avoid link saturation or to provide system resiliency?
  - Is there a much simpler, but perhaps less capable, system that can provide almost as much information sooner, or instead?
  - Can any machine process the message in a locally-acceptable format (ASCII comes to mind?).
- When the needs seem well scoped and about as simple as possible, then:

Information Architect Themes: **Dr. Eberhardt Rechtin, Internationally Renowned Systems Architect**

Group elements that are strongly related to each other.
Separate elements that are unrelated.
Choose a configuration that needs minimal communications between subsystems.
Never aggregate systems that have a conflict of interest.

- At this time there should be a well aggregated, well partitioned architecture designed to work. However such architectures can be brittle; that is, they are not designed to fail (properly).

  - Failing properly means failing catastrophically,
  - failing in a way that can not be diagnosed promptly,
  - failing when most needed, etc.

For this contingency,

Provide dissimilar redundancy for all critical functions.
(The Navy Ship Design equivalent: All spaces will have two exits.)

- This heuristic means that whenever possible, be able to perform all critical functions in at least two different ways; e.g.,
  - by data or voice,
  - by GPS or radar,
  - by satellite or microwave relay,
  - by different protocols,
  - by alternate weather sources,
  - by different airports,
  - by different computer programs…
- In any case, as is characteristic of all airliner design

There must never be a single point failure of the NAS as a whole, its information system included!

IV. <u>Thoughts on applicability to the NAS and its legacy systems, in particular</u>.

If you don't understand the existing system,
You can't be sure you are architecting a better one.

Unless constrained, rearchitecting has a natural tendency to proceed unchecked until it results in a substantial transformation of the system.

Given a change, if the anticipated actions don't occur,
Then there is probably an invisible barrier to be identified and

Information Architect **Dr. Eberhardt Rechtin, Internationally Renowned Systems Architect**
Themes:

overcome.

Dont try to do everything, much less all at once!

2.2 Work Group Sessions

During the 2-day conference, participants were worked in a series of parallel "working" sessions to actively contribute their knowledge and expertise to identify issues surrounding data architecture interoperability and develop strategies to overcome the identified issues. Each work group session was tasked to:

a. Decide on the boundaries of discussion and state them;
b. Produce a statement of the issues to be tackled and suggestions for how to address the issues;
c. Report on their preliminary work to the full session;
d. Produce a final session report (i.e., plan of action).

Six work groups addressed the following key interoperability questions:

1. **MANAGEMENT**: Dimensions and Challenges for Change
   What changes are required in the way the FAA does business in the 21st century's global information environment? How do we manage these changes? How do we manage expectations?

2. **NAS DATA QUALITY**
   What are the technical issues that must be resolved to ensure information quality -- data management, structure, access, measures of effectiveness, etc.? How will we establish a process for defining, assessing and verifying the levels of data quality needed for safe operation in the NAS?

3. **NAS BUSINESS OBJECTS**
   What data (business objects) are required by a NAS-wide information system? How do we identify and prioritize them?

4. **NAS FLIGHT INFORMATION OBJECT**
   How can dynamic flight information be structured and organized into an information object that meets the needs of NAS users and service providers? How do we identify and coordinate the work of various groups now doing Flight Object design and modeling?

5. **TRANSITION TO NAS INTEROPERABILITY**
   How do we standardize common-use NAS data and the business logic for interoperability? How do we manage standard information? How can we introduce commercial-off-the-shelf (COTS) information technologies and data standards in a cost- effective way? How do we capitalize on existing systems while transitioning to Free Flight?

6. **NAS-wide INFORMATION SYSTEM (NIS) PERFORMANCE**
   How do we ensure that NAS-wide information services will meet performance requirements for data availability, timeliness, latency, backup and recovery, and redundancy?

A comprehensive plan of action identifying interoperability issues and strategies to overcome these issues was produced by each of the six work groups. The full, unedited PowerPoint Slide presentations of each work group are provided on the NIAC web page (**http://www.faa.gov/niac**) and can be downloaded.

Session Leaders, familiar with the subject matter, let each of the work group sessions. FAA Facilitators assisted the Session Leaders in assuring that work group session discussions remained focused, mechanics ran smoothly, and that "the rules" of proper conference procedure were followed.

2.3 Closing General Session

After each of the six work groups made their presentation to the full conference, Felix Rausch, Co-Chair of the NIAC summarized the achievements of the two-day conference as follows:

- Let's not lose the momentum.
- We have harnessed positive energy, how do we retain it for the near future to accomplish the actionable items?
- How do we get the Administrator to take notice about what we have done, so as to make our job easier have a greater chance for success?

Mr. Rausch invited all participants to continue to contribute the NIAC effort by attending NIAC monthly meetings and actively participating in NIAC subcommittees. All conference registrants, whether or not they were able to attend the conference, will be e-mailed the Conference Proceedings Executive Report in May 1998. Mr. Rausch also mentioned that all speeches, support letters, and slide presentations from the general session and the work group presentations will be posted on the NIAC web page (**http://www.faa.gov/niac**).

Mr. Rausch thanked the entire group for their active participation and gave a special recognition to the FAA Facilitators who did an excellent job of making the work groups extremely productive in such a short time.

3.0 OVERVIEW OF CONFERENCE OUTCOMES

Overall, the conference met or exceeded the stated goals and objectives of the conference. The speakers and support letters in the general session set the right tone and provided a common basis for participants to work from. The Conference participants worked diligently and enthusiastically in the work group sessions and produced tangible and substantive outcomes, i.e., the six individual plans of action.

The major outcomes and action items of the six work groups are as follows:

3.1 **MANAGEMENT**: Dimensions and Challenges for Change

- Draft FAA policy on Global Aviation Information Management System (GAIMS)
- Free Flight Phase I (FFPI) Action Plan
  - Baseline FFP1: Data Model
    -- ASD-110 (NIAC), Industry
    -- Target Date: 9/98
  - Identify Data and Develop Tools to Support Metrics
    -- ASD-400, Industry
    -- Target Date: 12/98
  - Correct Site Adaptation Problems
    AOS/ACT
    Target Date: Start: 5/98
  - Identify Interoperability Opportunities for Follow-On FF Phases and NAS-Wide System Development Activities
    -- ASD-110
    -- Target Date: Start: 12/98

3.2 NAS DATA QUALITY

- Recommended Improvements:
  - Matrix of National, Local, & System versus Policies, Standards, & Data Structures
    -- Consistent National Policy
    -- Apply national standards locally
    -- Expanded Data Dictionary
- Action Plan
  - Create an Expanded Data Dictionary by1/1/00, NIAC
  - List goals for data quality by 20 May, Christopher Reilly (ACT-261)
  - Describe why requirements for DQ are necessary, 20 May, Timothy Foster (ACT-261)
  - Describe why data should be accessible to needed party by 20 May, John Niediewski (Houston ARTCC, Airway Facilities)

3.3 NAS BUSINESS OBJECTS

- Action Plan
  - Establish a work group to determine the following:
    - -- Scope
    - -- Outcome
    - -- Metrics
    - - Process(es)
    - -- WHO
      - --- Must have consistent participation
      - --- Must consist of stakeholders
      - --- Must have SME's in modeling, Object-Oriented databases, LOBs, facilitation.
  - Identify, address group learning needs
  - Identify, gather what's been done so far.
  - Determine what needs to be done, including coordination, integration, etc.
    - -- Look at sharing of data--ownership and management
    - -- Make recommendations for NAS-wide implementation

3.4 NAS FLIGHT INFORMATION OBJECT

- Action Plan
  - Establish Dialog
    - -- What: Work with Service Providers, Users and producers of major ATC DSS tools, e.g. CDM, CTAS, URET, and SMA.
      - --- What do they need from the FIO?
      - --- What can they contribute to the FIO?
      - --- How would they use the FIO?
    - -- Who: NIAC
    - -- When: 6 months - 1 year
  - Produce Standards
    - -- What: Define Standard for the FIO
      - -- Performance requirements
      - -- Relationships
      - -- Ownership
      - -- Interfaces
    - -- Who: NIAC
    - -- When: Calendar Year 2000
  - Produce Operational Requirements
    - -- What: Define Standard for the FIO
      - --- Performance requirements
      - --- Relationships
      - --- Ownership
      - --- Interfaces
    - -- Who: NIAC
    - -- When: Calendar Year 2000
  - Define Memoranda of Agreement (MOA)
    - -- What: Work with Air Traffic Service Providers and Users to define Operational Requirements
    - -- Who: ARS
    - -- When: Calendar Year 2000

3.5 TRANSITION TO NAS INTEROPERABILITY

Recommendations

- Establish Coordinated Repository Under CM for:
  - data standards
  - processes
  - object definition
  - Application Program Interface (API) library
  - terminology and definition
  - scope (what's in what's out)
  - set of COTS tools & browsing and search capability
  - definition of common operating environment
  - object registration
- Prioritize/Categorize Data to be Shared
  - Institute a Corporate Data "IPT"
    - -- Shift data ownership paradigms
  - Identify the complete technical landscape
    - -- Map to systems including Common Information Services
    - -- Identify gaps and overlaps
    - -- Arbitrate
  - Align budgets and schedules to execute
  - Determine where in the organization this IPT should live
- Facilitate Interoperability Across Stovepipes
  - Institute an Interoperability IPT
  - Define the Interface/Integration standards
    - -- Hierarchy of interoperability
      - --- Network-centric
      - --- Data-centric
      - --- Service-centric
  - Conduct proof of concept demonstrations to allay fears
  - Institute processes that span the FAA to introduce common objects and standardize interfaces
- Get NIAC charter signed at the Associate level
- Incorporate process & organization to proceed with development of the Data Architecture in sync with the next version of the NAS Architecture

3.6 NAS-wide INFORMATION SYSTEM (NIS) PERFORMANCE

- Action Plan
  - Answer Question #1: Who are the Users?
    - -- Conduct user survey, organize the data into a matrix.
    - -- Identify the groups based on performance characteristics.
    - -- Validate the NAS architecture against performance requirements.
    - -- Sponsor "Industry Day" to aid in determining related industries.
    - -- Update architecture to meet or beat performance.
  - Answer Question #2: How many users do you have to service?
    (We need to size system to optimize capacity based on # of users)
    - -- Get tools that allow this work to be done efficiently.
    - -- Make available/accessible throughout stake holders.
    - -- Training on tools, principles.
    - -- Collect Data (on # of users) from other projects for starting/improving of models.
    - -- Survey/methodology for collecting impact analysis items surveyed
    - -- Examine cost/benefit analysis of the DSTs.
    - -- Estimate value of computation to DST, accuracy and timelines
    - -- Simulation/testing by varying input accuracy, timeliness & observing quality of output.
    - -- Feedback of comparison of models with actuals for improvement of models.
  - Answer Question #3: How do we define metrics of each performance requirement?
    - -- Who: FAA
    - -- When: By design review and with set intervals between acceptance testing.
    - -- What: All approaches.
  - Answer Question #4: How do we prioritize when multiple users wish concurrent access?
    - -- Research
    - -- Perform alternative analysis of network arch. based on research results.
    - -- Define classes of access
    - -- Draft of user agreements
    - -- Develop degradation plan
    - -- Coordinate user agreements
  - Answer Question #5: How do you translate operational requirements into specific information architectural performance requirements?
    - -- Use the acquisition management system
    - -- Derive initial requirements for CONOPS from JRC1
    - -- Perform investment analysis
    - -- Prototyping
    - -- Simulation
    - -- Identify/develop metrics for performance requirements for JRC 2

4.0 SUMMARY OF CONFERENCE EVALUATIONS

PLEASE RATE EACH ITEM BY PLACING A CHECK (✓) IN THE APPROPRIATE COLUMN.
1 = NO or DISSATISFIED
2 = SOMEWHAT SATISFIED
3 = YES or VERY SATISFIED

A. WORKING SESSION		**1**	**2**	**3**	**Total**
1.	The session scope was pertinent to my interest(s).	8.3%	30.5%	61.0%	72
2.	The Session Theme was appropriate.	5.5%	50.5%	63.8%	73
3.	The Key Questions were appropriate.	27.0%	42.2%	30.9%	71
4.	The Session Leader kept the group focused on the topic.	16.9%	47.8%	38.0%	73
5.	Discussion was relevant to the topic.	12.5%	36.0%	51.3%	72
6.	Participant questions were addressed.	5.7%	42.8%	51.4%	70
7.	Participant grouping was appropriate.	15.4%	46.4%	38.0%	71
B. SPEAKERS		**1**	**2**	**3**	**Total**
8.	Keynote Speaker's presentation was tied to the theme.	1.4%	28.0%	70.4%	71
9.	FAA Staff presentations were tied to the theme.	2.7%	27.3%	69.8%	73
10.	IA Expert's (E. Rechtin) presentation was tied to the theme.	0.0%	10.7%	89.2%	65
C. FACILITY		**1**	**2**	**3**	**Total**
11.	The Facility was appropriate.	0.0%	15.0%	84.9%	73
12.	The Breakout room was appropriate.	8.2%	23.2%	68.4%	73
13.	The Conference audiovisual equipment was appropriate.	0.0%	13.6%	86.3%	73
D. GENERAL CONFERENCE		**1**	**2**	**3**	**Total**
14.	Registration was smooth.	0.0%	8.4%	91.5%	71
15.	The conference objectives were met.	9.8%	38.0%	52.0%	71
16.	I intend to actively participate in follow-on activities planned in my group.	8.5%	28.5%	62.8%	70
17.	I would attend other FAA forums on Interoperability.	5.6%	19.7%	74.6%	71